

Crossing Borders: The Beauty of Computer Science Beyond Disciplinary Borders

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ABSTRACT

Incorporating diverse perspectives, particularly those of women, into the development of emerging technologies is vital for innovation, sustainable product design, and ethical integrity. However, women remain underrepresented in STEM fields, particularly in computing. Our poster highlights the pivotal role of educational initiatives in addressing this disparity and shaping the future of computing. We present insights into the RockStartIT initiative, tailored to increase girls' representation in STEM, specifically computer science (CS). By offering interdisciplinary courses aligned with students' interests, RockStartIT has successfully engaged diverse groups of high school students in. Through engaging expeditions, participants explore the beauty of CS in different contexts and its applications in solving real-world challenges closely aligned to their everyday experiences. We propose our IDEA (Interdisciplinary, Diverse, Exploratory, and Active) framework to provide alternative pathways into CS education. By leveraging students' individual interests, RockStartIT fosters inclusivity and promotes a deeper understanding of CS's interdisciplinary nature. Our poster invites discussions on the impact of educational interventions in promoting gender equality in computing and shaping responsible computing practices for the future.

KEYWORDS

Diversity, interdisciplinarity, computer science education, e-learning

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1 INTRODUCTION

Incorporating diverse perspectives, particularly those of women, into the development of emerging technologies is not just a matter of equity; it's also vital for driving innovation, ensuring sustainable product design, and upholding ethical integrity [1, 11, 12].

Klawe and Shneiderman [7] advocated for computer scientists to embrace interdisciplinary collaborations as a means to attract top talent, stimulate public interest, and broaden available resources.

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In our rapidly evolving society, characterized by interdisciplinarity and transdisciplinarity, such collaborations have become indispensable for driving research and technological progress [2]. Jobs offering interdisciplinary working areas are in turn also more appealing to women [3].

With the RockStartIT initiative, we explicitly aim to utilize the benefits of interdisciplinary environments to attract a more diverse audience. Traditional CS curricula often struggle to resonate with female students, who may find it challenging to identify with the field's dominant culture. Thus, we create interdisciplinary courses providing students with context, that resonates with their personal interests in different fields.

Given the low enrollment of female students in technology-related tertiary education, addressing this challenge at all stages of education is crucial. Through our poster, we aim to provoke discussion and explore ideas for engaging more young women in CS using interdisciplinary approaches.

2 IDEA CONCEPT FOR ENGAGING LEARNING

RockStartIT is an initiative that seeks to provide innovative and engaging online courses. To ensure that our courses are effective, we have defined the IDEA (Interdisciplinary, Diverse, Exploratory, Active) concept based on previous research [4, 6]. This concept consists of four key elements that form the basis for all of our courses (see Fig. 1), and that we continuously seek to improve:

Interdisciplinary. All of our courses are interdisciplinary. This means that they connect topics from different domains to provide students with authentic and meaningful learning contexts. The interdisciplinary nature of our courses enables students to explore and connect with their interests, fostering a sense of personal relevance and motivation that enhances their overall learning experience.

Diverse. By incorporating a variety of topics, viewpoints, didactic principles, adaptive learning techniques, and interactive multimedia resources, our courses provide a tailored learning experience that caters to the unique needs and preferences of each student.



Figure 1: IDEA concept of RockStartIT

This approach promotes individual growth, fosters self-paced learning, and allows students to engage with the course material in a way that best suits their learning style, ultimately maximizing their comprehension and retention of the content.

Exploratory. The exploratory nature of our courses empowers students to embrace curiosity, take intellectual risks, and delve into uncharted territories, nurturing their creativity and enabling them to uncover innovative approaches for tackling complex challenges and contributing to meaningful solutions.

Active. We foster active learning in our courses by implementing a diverse range of engaging and activating concepts, spanning from simple multiple-choice questions and interactive discussions to collaborative projects and real-world case studies such as programming and designing tasks, empowering students to actively apply their knowledge and skills, cultivate critical thinking abilities, and develop practical expertise in their chosen fields.

3 UNLEASHING LEARNING ADVENTURES: FROM SIMPLE ONLINE COURSES TO CAPTIVATING EXPEDITIONS

RockStartIT offers a unique approach to learning through its interdisciplinary courses. We call them “expeditions” as they transcend traditional online courses by immersing students in immersive journeys where they engage with real-world problems. Guided by captivating settings, questions, or challenges, students naturally explore concepts using CS methods, technologies, and data. They collect and analyze data, and apply CS methods and technologies to reason, observe, evaluate, and draw conclusions. This hands-on approach fosters a deeper understanding of CS concepts and their practical applications, surpassing the limitations of traditional introductory CS courses. All of our expeditions are inspired by topics that, at first glance, are often rooted in other domains but offer the potential to illustrate the strengths of CS and its applicability to achieve more extraordinary things. Our vision is to provide a comprehensive variety so that every student can choose a suitable start in CS connected to their personal interests. In the following, we outline three of such expeditions (available at rockstartit.com):

Beyond Biology - Save the Bees. This series of expeditions combines STEM and biological phenomena with CS as students explore the application of technology to solve significant challenges such as colony collapse disorder. In their first expedition, students are introduced to the biological background and the problem statement of “How can we help the bees?”. In the second expedition, students learn the basics of web development and build a website to inform people about the problem. The third expedition focuses on data science, teaching students about suitable data storage strategies and how to use SQL to search for answers. The fourth expedition investigates if all bees that leave the hive also return and how AI can help count the bees. In the fifth expedition, students become project managers and learn about the benefits of building a team to approach big problems.

Beyond Physics - In Search of Other Life. In the physics-related expeditions series, students go on expeditions to search for extraterrestrial life. They start by learning the basics of rocket

science to get their rocket into space. They write a program for their rocket using scratch projects, learning about control structures and variables. Next, they learn about camera sensors and signal processing using time-lapse photography. Then they learn how to digitize and store images as pixels before exploring error correction mechanisms to send the images back to Earth without interference. With their newfound knowledge, they can securely transfer their images and set the stage for future expeditions.

Beyond Geography - Save the Climate. In this course, students explore computational thinking concepts through the lens of climate change. The course is designed to be integrated into various subjects, with a focus on motivating students to make a real-life impact on the environment. Through a fictional character named Ida, students learn how to live a climate-friendly and sustainable lifestyle. The first expedition introduces fundamental principles of computational thinking, and how they can be used to solve big problems such as the greenhouse effect. In the second expedition, students learn about sustainable nutrition by sorting legumes using decomposition and bucket sorting. In the third expedition, students explore information coding, such as supermarket bar codes, to label fruits and vegetables seasonally for sustainability.

4 CASE STUDIES

In several case studies we evaluated the impact of our interdisciplinary courses on students’ interest in CS [5]. As a survey instrument, we use a self-developed questionnaire [10] based on the person-object-theory of interest (POI) [8]. The results from the surveys conducted with program participants have shown that the program has been successful in increasing interest for CS among diverse groups of learners. Particularly girls showed to be highly engaged by the program indicated by significant increases in positive feelings and future intents related to CS. But our courses show also high potential in engaging students in general, especially students that initially showed low self-efficacy in CS or that did not like coding for any given reason [9, 10].

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